

Attachment 1

Specific Recommendations for the Hydrogen Highway Project July 8, 2004

This document supplements the California Fuel Cell Partnership (CaFCP) white paper “Facilitating Fuel Cell and Hydrogen Commercialization and Adding Value to California’s Hydrogen Highway Network”. In that document, the CaFCP offers to provide specific recommendations regarding the planning and implementation of the Hydrogen Highway initiative. This document provides the CaFCP’s specific recommendations.

Strategy for Siting, Developing and Utilizing Stations

A successful strategy for placing stations will encourage the effective usage of each station and maximize the ability of hydrogen vehicles to travel throughout the state. Stations that are rarely used, due to low vehicle volume or low hydrogen throughput, do not provide much learning experience. In addition, the scarce resources available and the lack of a near-term commercially viable business case indicate that we should try to maximize our benefit per investment dollar.

For the next 6 years, hydrogen fuel cell vehicles will be very expensive—approximately one million dollars for a light-duty vehicle and two million dollars for a bus. Although there is a great deal of work being done by the fuel cell engine and vehicle manufacturers to reduce this cost, it will be many years before this cost premium is reduced sufficiently to allow for large volumes of vehicles to be produced and sold. Current forecasts are for cumulative industry volumes in California to be up to 300 units by 2008, with some portion of these vehicles in daily use (many of these vehicles are early prototypes, and the number on the road at any given time will be lower). Potential growth, dependent upon technology advances and market demand, of up to 8 times the 2008 level is possible by 2012, assuming that the cost reduction efforts have been successful. Additional applications requiring hydrogen fuel, such as internal combustion vehicles fueled with hydrogen or a hydrogen and compressed natural gas blend, fuel cell auxiliary power units (APUs) for long-haul trucks, fuel cell buses, and stationary fuel cell power units, could increase the demand for hydrogen, and encourage more infrastructure development or utilization. Current technology hydrogen fuel cell vehicles require a very high quality of hydrogen to ensure fuel cell stack durability and fuel system integrity. Therefore, any other users would either have to pay the premium for this high quality fuel, or they would need dedicated sources of hydrogen.

Because of this restricted number of vehicles, the new stations must be placed to allow maximum station usage. This implies concentrating the stations in locations convenient for fuel cell vehicles or other users, such as in urban environments. This will better match customers and fuel providers and allow for reasonable hydrogen consumption at each station. These urban clusters form the beginning of a network, and can then be gradually linked together by carefully placing a minimum of stations along the major

travel routes. As an example, the Sacramento area can be linked to the San Francisco area by one station placed between the two cities on Interstate 80.

In every case, safety should be the first and foremost concern. Only those hydrogen production and delivery methods that have undergone safety validation and reliability testing, and have been approved by permitting authorities should be utilized. This is especially important for publicly accessible stations that may not be monitored, controlled, or inspected to the same degree as the CaFCP demonstration equipment. State and local fire and safety officials should be fully involved to ensure a thorough review of station proposals.

The hydrogen fueling stations should provide specific benefits, such as safely demonstrating a range of production and delivery approaches, or realizing low-cost technologies. For example, stations may use a number of existing technologies. These may include electrolysis from renewable energy, natural gas or other feedstock reformation. Consideration should also be given to the expanding commodity distribution system (particularly natural gas and hydrogen pipelines) and how the hydrogen fueling network may become integrated as a downstream component of the system. These technologies may not be the most cost-effective approaches in the near-term, but they provide important benefits to establishing a fueling system for improving fuel cell technologies and exploring their potential for the future. Any technology used should have been thoroughly tested for safety before being deployed. Stations that are implemented primarily to expand the fueling network should utilize proven technologies that reduce the capital cost of the stations to help minimize the stranded investment during this initial period. It should also be possible to upgrade stations or modify the hydrogen source as other technologies are proven to be suitable for deployment and integration into the national infrastructure.

As the vehicle numbers begin to increase, the urban clusters can be expanded, and the linkages increased to create a usable network for intrastate travel, including commercial truck and bus travel. Eventually, linkages to other states may be feasible when their hydrogen vehicle population also increases. An example map of hydrogen fueling infrastructure in 2012 is included as Attachment 2. A chart indicating an infrastructure rollout approach is included as Attachment 3.

Some specific recommendations:

1. In the early years, focus the placement of fueling stations in urban areas where the vehicles are concentrated.
2. Utilize only those technologies that have successfully completed demonstration and meet the necessary safety/risk, reliability and confidence criteria.
3. For stations where the primary goal is to expand the network, use low capital cost approaches to minimize stranded investment, such as mobile fueling stations.
4. Promote publicly accessible hydrogen stations and use by qualified users, to encourage public acceptance.
5. Public/Private partnerships may be necessary to fund station development during this non-commercial period.

6. In concert with DOE initiatives, invest available funds in research and development of distributed hydrogen generation (e.g. electrolysis and natural gas reformation) as a complimentary component to fixed infrastructure.
7. Link the urban concentrations together with a minimum of stations to allow some inter-urban travel. Whenever possible, choose sites that have room for expansion as warranted by vehicle demand.
8. Investigate other hydrogen uses, such as hydrogen internal combustion vehicles, fuel cell buses, energy stations, long-haul truck APUs and industrial uses to increase throughput of the fueling stations.
9. Consider future consumer incentives for the use of hydrogen fuel as vehicles costs are reduced to the point where vehicles can start entering the consumer market and demand for the fuel begins to increase.

Facilitating the Development of the Hydrogen Highway

Although hydrogen has been used in industrial applications for many years, hydrogen use in transportation is a very new application, and fuel cell vehicle technology is very immature. A large number of national codes and standards are still in development, and many regulatory and safety officials do not have sufficient experience to expedite permitting of hydrogen facilities. As a result, station developers face an environment where different requirements can be placed by many agencies, and where there is a lack of standardization. This not only slows the process considerably, but it also increases costs, diminishing the resources available for more stations. A more consistent statewide application of regulatory requirements, approval and permitting streams would be helpful in enabling station development. Because the technology is not fully mature, it will be necessary to evolve these requirements in the future as our experience with this fuel increases. At this stage, a periodic review of these standards might be helpful to ensure that we do not “freeze” into regulations our incomplete understanding of this technology.

Some specific recommendations:

1. Provide educational materials for state and local building officials, fire marshals, and safety departments to increase their knowledge concerning hydrogen use and safety.
2. Create a California “hydrogen ombudsman” to help local officials and developers satisfy these regulatory and safety requirements.
3. Promote a template for siting and developing stations, such as the CaFCP Station Implementation Guide
4. As part of the public outreach program, communicate the need for hydrogen and provide safety information to the general public to minimize public concern about hydrogen fueling and vehicles.
5. Establish a periodic review of applicable codes, standards, and regulations to encourage updates as the technology matures. Coordinate updates with the U.S. Department of Energy and U.S. Department of Transportation.

Encourage the Development of Low Cost Fuel Cell Vehicles

Vehicle and technology manufacturers are investing heavily in improving the performance and reducing the costs of fuel cell vehicles, but there are areas where help is needed. During the high cost period, public/private partnerships can be useful to encourage the steady increase of volume and provide the necessary manufacturing experience for cost reduction. California's universities can be encouraged to research such areas as increasing stack durability and hydrogen storage. California's assistance to this new industry will be helpful in encouraging investment in suppliers who do not currently have a good business case, and would indicate leadership in supporting the long-term development of the industry.

Some specific recommendations:

1. California agencies should support the purchase and use of hydrogen fuel cell vehicles, for example by placing vehicles in state and university fleets and providing incentives for others to do the same.
2. California universities should be encouraged to conduct research in key areas to promote lower cost and higher performance vehicles.
3. Long-term support from California government is critical to encourage private investment. For example, any tax incentives or credits that are enacted should be effective over multiple years.

Reducing Concerns on Legal Liability and Insurance

Vehicle manufacturers and fuel providers manage their legal liability on the current gasoline and diesel technology. Because there is little legal precedent for hydrogen vehicles and fueling, the legal liability for these products is unclear. Concerns that extraordinary interpretations of legal liability will be developed may restrict the willingness of the manufacturers and fuel providers to expand beyond the currently planned small demonstrations.

In addition, vehicle operators, station owners, dispenser equipment manufacturers, etc. will need access to liability insurance at fair and reasonable rates. Insurers do not have any meaningful experience to determine the correct pricing of this insurance, and there is some possibility that it either will not be available at all, or available only at a prohibitive price.

Some specific recommendations:

1. Require that users of hydrogen fueling stations be properly trained and authorized.
2. Use only tested and safe technologies for fueling stations
3. Develop legislation providing an acceptable level of liability for vehicle manufacturers and fuel suppliers.
4. Provide regulatory guidance to the insurance industry to encourage the availability of reasonably priced insurance for vehicle operators and fuel providers.

Public Education

The CaFCP and other stakeholders have an active program to educate the public concerning the advantages of fuel cell vehicles and the status of their development, but more needs to be done. California can help to avoid the public perception of safety concerns with this new fuel as well as identify clearly the expected benefits.

A specific recommendation:

1. Develop a comprehensive, state-supported educational program promoting the consumer and societal benefits of hydrogen fuel cell vehicles and explaining the use and safety of hydrogen fuel.

Renewable Energy Development

The CaFCP strongly supports a sustained level of research and development to maximize the availability of clean and renewable hydrogen sources. In the near term, the use of conventional fuels to produce hydrogen can provide a transition to a renewable hydrogen future. By developing both vehicles and their associated infrastructure, the necessary elements can be readied to use hydrogen produced from renewable and clean sources when it becomes widely available.

The long-term success of hydrogen as a fuel is tied to the successful development of cost-effective renewable energy sources. Hydrogen can be provided for the near-term vehicle demonstration programs without the use of renewable energy sources. However, hydrogen from many sources, including renewable energy, should be used to ensure that the short-term objective of meeting the fueling needs of the demonstration fleet and the long term objective of developing cost-effective renewable sources are both achieved.

Some specific recommendations:

1. Acknowledge that the Hydrogen Highway project will use fuel derived from both renewable and fossil energy sources.
2. Encourage research into low cost, commercially viable sources of renewable energy. Consider California universities as a research base in this area.
3. Encourage the use of renewable energy sources through incentive programs.